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Implementation of weak measurement for single nuclear spin qubit by using cavity enhanced Faraday rotation ATSUSHI NOGUCHI, YUJIRO ETO, NOBUYUKI TAKEI, MAKOTO TAKEUCHI, PENG ZHANG, MASAHITO UEDA, MIKIO KOZUMA, TOKYO INSTITUTE TECHNOLOGY TEAM, ERATO MACROSCOPIC QUANTUM CONTROL PROJECT, JST COLLABORATION, UNIVERSITY OF TOKYO COLLABORATION — When an off-resonant light field is coupled with atomic spin, its polarization can rotate depending on the direction of the spin via a Faraday rotation. Because the Faraday rotation deterministically entangles atomic spin states with photonic polarization states the information of the spin can be obtained by performing projective measurement on the ancillary photon. Employing the proper measurement basis, not only projective but also weak measurement can be implemented for the spin state. Here we report the observation of Faraday rotation by an angle of more than 10° for a single 1/2 nuclear spin of the 171Yb atom. Nuclear spin is the promising candidate of the quantum bit because of the long coherence time due to its extremely small magnetic moment. In our experiment, Faraday rotation was enhanced by using a high-finesse($\sim$100,000) optical micro-cavity. We also measured variation of the spin state after single photon counting of the transmitted weak probe pulse. The spin state was either projected or weakly measured.

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